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ABSTRACT

The University of Denver Libraries employed SCORE (Service Components Reliability and Efficiency), a cost analysis technique, to measure effectiveness and cost of reference activity. This report examines the results and the problems encountered in application of this methodology. A reference model, designed as a flow chart, was developed by defining and sequencing the activities and events common to all reference queries. Statistical data for 959 questions recorded by reference librarians on SCORE Analysis Data Sheets included time for each activity, which was estimated during the first week of the study and timed by stopwatch during the second and third weeks. Cost effectiveness was calculated for both professional and para-professional staff, with cost per question based on time spent and the average wage of the processing personnel. The flow charts and data sheets are appended. (JAB)

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# SCORE, A measurement of reference service

by

Richard J. Beeler

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# SCORE, A Measurement of Reference Service

by Richard J. Beeler

## Introduction

During the academic year 1974-75, the University of Denver Libraries conducted an experiment to measure reference activity through the use of a cost analysis technique. The technique employed was a modified form of the SCORE (Service COmponents Reliability and Efficiency) analysis developed by C.J. Wessel and K.L. Moore in their study of evaluation methodologies applicable to the Army Technical Libraries.[1] This report will examine the results of the University of Denver experiment and the problems encountered in the application of the SCORE methodology.

SCORE analysis uses a system simulation model to quantify both the effectiveness and cost of the activity studied. Effectiveness is calculated by determining the probability of occurrence of all component activities, or events, essential to satisfying defined service objectives. In the case of reference service, this calculation is permitted by measuring, for a small population of questions, or information needs, that percentage which passes each sequential activity. Cost is represented by direct labor costs, determined by the product of wage rates and time spent on each information need.

The SCORE method seems particularly well suited to reference analysis. Unlike other measurement techniques, SCORE makes no attempt to record the subject content of the questions asked or the specific source materials used to locate relevant information.[2] While data of this type can be useful, they contribute little to an understanding of the overall success of reference activity. SCORE also avoids the problem of describing a standard reference unit sufficiently distinct to allow for simple arithmetical measurements. Although such a unit

was suggested nearly two decades ago by Louis Shores, we seem no nearer its definition now than in the early 1960's. But perhaps the most appealing aspect of the SCORE technique is the promise of performance comparisons between libraries offering the same services. Although not discussed by Wessel and Moore, such comparisons should certainly contribute to the adoption of those types of organizational, procedural, and staffing patterns having demonstrated effectiveness.

The Reference Model

The initial task in applying SCORE to reference activity, or any library function is identifying the events which are at once common to all transactions to be studied, and necessary to the successful completion of each transaction. Given the extreme diversity among reference questions, defining those common elements may seem at first an insurmountable task. Ignoring subject content, however, a number of recurring elements can be seen. For example, in each reference transaction, the earliest reference event occurs when the patron contacts the librarian and expresses an information need. Simple at this step seems, it is virtually the only aspect of the reference process recorded on the typical statistics form. Following this first event, the librarian's tasks are to achieve an understanding of the need, through what has come to be known as the reference interview, and then to formulate a strategy for locating the desired information. While this pattern can be seen repeatedly in reference questions, it does not by itself gauge the success or failure of the search.

In their discussion of the SCORE method, Wessel and Moore assume reference transactions are unsuccessful if the librarian does not actually retrieve for the patron documents containing the needed information. According to this view, cases in which the librarian suggests a search methodology,

but does not actually accompany the patron through the process of identifying and retrieving such material, could not be considered complete, regardless of the caliber of the instruction or the user's ultimate success in finding appropriate material.

Since, in the University of Denver study, these types of assumptions were felt to be unrealistic, the objective of reference service was defined for the study as satisfying the informational needs of library patrons by either: (1) retrieving the specific information sought by the patron, or (2) providing sufficient instruction in the use of library materials to enable the patron to retrieve such information. Determining which of these two courses of action best suited a particular reference inquiry was left entirely to the judgment of the librarian involved, as was the determination of what constituted "sufficient" instruction.

Using this view of the reference objective, additional events common and necessary to the processing of each reference question were defined and arranged sequentially to form a reference model (Figure 1). The inclusion of library instruction in the objectives statement necessitated the modification of the Wessel and Moore sample model, which does not accommodate this activity. As seen in Figure 1, this change was made by creating two exit paths. The upper path, containing Events 3 and 4, reflects the activity of the librarian when the instructional option has been exercised. The lower path, containing Events 5 and 6, follow the Wessel and Moore chart for the retrieval of documents and the verification of information relevant to the patron's question.

SCOREing

Following the development of the reference model, the next step in using the SCORE technique is the collection of statistics on the number of

reference questions processed during selected time periods, and recording, for each question, the information required by the SCORE analysis data sheet (Figure 2). In the University of Denver study, data were collected during three non-consecutive weeks.

The required information was collected by the librarians answering each question. Initially, some thought was given to having observers record the data, but this approach was rejected after experimentation showed it to be unworkable. During the first week of data collection, librarians were asked to estimate the time spent on each activity. During the second and third weeks, stop watches were issued to the staff, and a more accurate record was maintained.

It was the intent of the study only to examine how reference questions were processed. The more simple type of inquiries often referred to as directional questions were not included. However, as should have been anticipated, some confusion existed concerning the distinction between these two types of transactions, and formal definition became necessary.

Directional questions were defined as those not requiring professional bibliographic training or the consulting of resource materials. The vast majority of questions of this type entailed telling the patron where a particular person, object, or place could be found in the library or on campus, or relating information concerning the library's regulations and operating procedures which were of common knowledge to library staff (e.g. closing times, loan periods, borrowing privileges, etc.). For the purposes of this definition, "resource materials" were interpreted to exclude the campus directory, campus maps, and library floor plans. In contrast, reference questions were defined as those which did call upon the librarian to utilize

his or her bibliographic training, and often, but not always, requiring the librarian to consult resource materials to obtain information.

The structure of the SCORE analysis data sheet closely follows that of the reference model, although the question numbers on the form do not totally correspond with the event numbers used in the model. While the data sheet certainly did not intend to be misleading, a number of questions arose during data collection, especially regarding the distinction between Questions II and III. Question II, "Did the librarian suggest a search methodology?" was meant to refer to the librarian suggesting library tools which in the opinion of the librarian were likely to contain the type of information sought. Referral need not have been made to specific titles if some other more general description was sufficient for the patron to locate appropriate sources. Question III, "Was instruction in the use of the above materials provided?" properly merited an affirmative response only if the librarian explained the scope and arrangement of a specific tool and/or the method of using that tool in order to retrieve the particular information sought.

Results

During the periods studied, 959 questions were processed by the University of Denver reference department. From the data collected, it was possible to calculate the probability of questions passing each event. Figure 2 shows that, of a total 420 information needs, 416 passed Event 3. The probability of passing this event was computed by the simple division:

$$\frac{416}{420} = .99 = 99\%$$

Similarly, probabilities for Events 2-6 were calculated, as was the probability of a question being shifted to the upper or lower exit path at the decision box labeled "librarian considers information need."

Using these event probabilities, it was possible to calculate the probability of passing all sequential events to an exit either at point A or point B. This probability of success is defined as the system's "effectiveness" and is calculated in the following manner:

$$\text{Effectiveness } (E) = (PA)(P_{e2})(P_{e3})(P_{e4}) + (PB)(P_{e2})(P_{e5})(P_{e6}) ,$$

where PA = the probability of an information need passing along the upper, or A, exit path;

PB = the probability of an information need passing along the lower, or B, exit path; and

$P_{en}$ = the probability of event "n" occurring.

Based on the information shown in Figure 3, the effectiveness of the reference department studied can be calculated as:

$$E = (.439)(.997)(.990)(.653) + (.561)(.997)(.991)(.857) = .756$$

Thus, 75.6% of the questions entering the system could be expected to exit either at point A or point B.

Fifteen percent of the questions recorded during the SCORE analysis were processed by members of the paraprofessional staff, all graduate students working toward degrees in library science. With the formula for effectiveness of the paraprofessionals to that of the professional librarians. As can be seen, the professional figure is much higher:

$$E_{prof} = (.432)(1.00)(.994)(.697) + (.568)(1.00)(.991)(.867) = .787 , \text{ and}$$

$$E_{para} = (.483)(.979)(.929)(.424) + (.517)(.979)(1.00)(.794) = .587 ,$$

where $E_{prof}$ = the effectiveness of the professional staff, and

$E_{para}$ = the effectiveness of the paraprofessional staff.

For the most part, this difference in effectiveness figures was caused by the paraprofessional's slightly higher tendency to choose the upper, or instructional, exit path (48.3%, compared to 43.2% for the professional staff) coupled with

their penchant not to instruct patrons in the actual use of the materials to which they referred (42.4%, compared to 69.7% for the professional staff). The professionals were also slightly more successful in locating the information required to answer the user's question if following the lower section of the chart (86.7%, compared to 79.4% for the paraprofessionals).

Cost per question was calculated based on time spent per question and the average wage rate of the personnel processing the questions. The average wage rate for the professional staff was calculated at .168¢ per second. Taking the average times per activity from Figure 4, the cost per question processed by a professional was:

$C_{prof}$ = (.168¢/sec) $\left[(.432)(46.0+83.6+136.8) + (.568)(46.0=68.8=116.4)\right]$sec ,

which becomes,

$C_{prof}$ = (.168¢/sec)(246.0sec) = 41.4¢.

Similarly, calculating the average wage rate for paraprofessionals at .07¢ per second, and using the average times per activity from Figure 5, the cost per question processed by a paraprofessional was:

$C_{para}$ = (.07¢/sec) $\left[(.483)(22.0+67.6+138.9) + (.517)(22.0+37.5+181.5)\right]$sec ,

which becomes,

$C_{para}$ = (.07¢/sec)(238.0sec) = 16.5¢.

Again, an interesting distinction between professional and paraprofessional staff can be seen in the average times spent per question. The professionals spent 246.0 seconds, or 4.1 minutes, per question; the paraprofessionals spent 235.0 seconds or 3.9 minutes. While these times are similar, the professional librarians devoted twice as much time to the reference interview as did the other group (46.0 seconds and 22.0 seconds, respectively).

An average departmental cost per question was determined by multiplying

the costs derived above by the percentage of questions answered by the respective group:

$$C = (41.4¢)(.85) + (16.5¢)(.15) = 36.66¢ .$$

Only in comparison do these findings achieve real substance. If, for example, the department studied were to undergo a major change in organization or policy, new figures of effectiveness and costs could be determined and used to evaluate the desirability of the change. Likewise, if another institution were to perform a similar experiment with markedly different results, the SCORE findings would become the logical basis for investigating the relative cost and effectiveness ratios of one library to the other. To facilitate such comparisons, Wessel and Moore suggest calculating an index of cost-effectiveness by average costs. Using the figures reported above, the result of this computation is 2.007. Generally, an increase in this index would be increasing more rapidly than cost, or at least decreasing more slowly than cost. By contrast, a change resulting in a relative increase in cost compared to effectiveness would result in a decrease in the cost-effectiveness index, signaling an undesirable situation.

Even without comparative cost/effectiveness studies, support for the above performance figures can be found in the literature, albeit from two widely divergent sources. A survey of telephone reference service in the Baltimore area in 1974 found that approximately 70% of the test questions were answered satisfactorily, a percentage not unlike the 75.6% recorded by the detailed SCORE method.[4] Equally interesting is a time study of general reference service conducted at the University of California at Davis, which found the average time spent on reference questions representing "truly professional desk work" to be 4.87 minutes, which compares favorably with the 4.10 minutes determined by SCORE as the average time spent per question by the

professional staff.[5] As intriguing as these comparisons may be, however, useful interpretation of the University of Denver statistics must await future applications of SCORE of similar analysis techniques.

With regard to future uses of this type of analysis, an observation based on the Denver experiment may prove beneficial. By far the major problem encountered in using SCORE concerned data collection. This was an extremely awkward and time-consuming process, in spite of efforts to simplify the data collection form. Our experience indicates that some way must be found to free the reference librarian from the data collection task if detailed time studies, such as this one at the University of Denver, are not to interfere with the very service being studied.

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1. C.J. Wessel and K.L. Moore, Criteria for Evaluating the Effectiveness of Library Operations and Services - Phase III. Recommended Criteria and Methods for Their Utilization, (Washington, D.C.: John I. Thompson & Company, 1969). Available from N.T.I.S. as AD 682 758.

2. A number of excellent reviews of reference measurement techniques have appeared; two of which are:
Terry L. Weech, "Evaluation of Adult Reference Service, "Library Trends, 22:315-35, January, 1974.
Manuel D. Lopez, "Measurement, Cost and Value: Academic Reference Service," RQ, 12:234-42, Spring, 1973.

3. Louis Shores, "The Measure of Reference," Southeastern Librarian, 11:297-302, Winter, 1961.

4. "Maryland Reference Service Evaluated by Phone," Library Journal, 99:3166, December 15, 1974.

5. Edward C. Jestes and W. David Laird, "A Time Study of General Reference Work in a University Library," Research in Librarianship, 2:9-16, January, 1968.

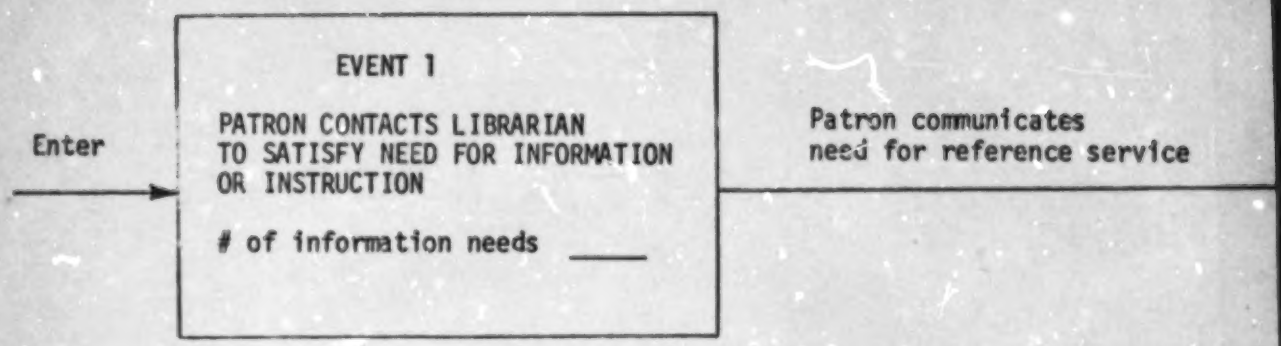
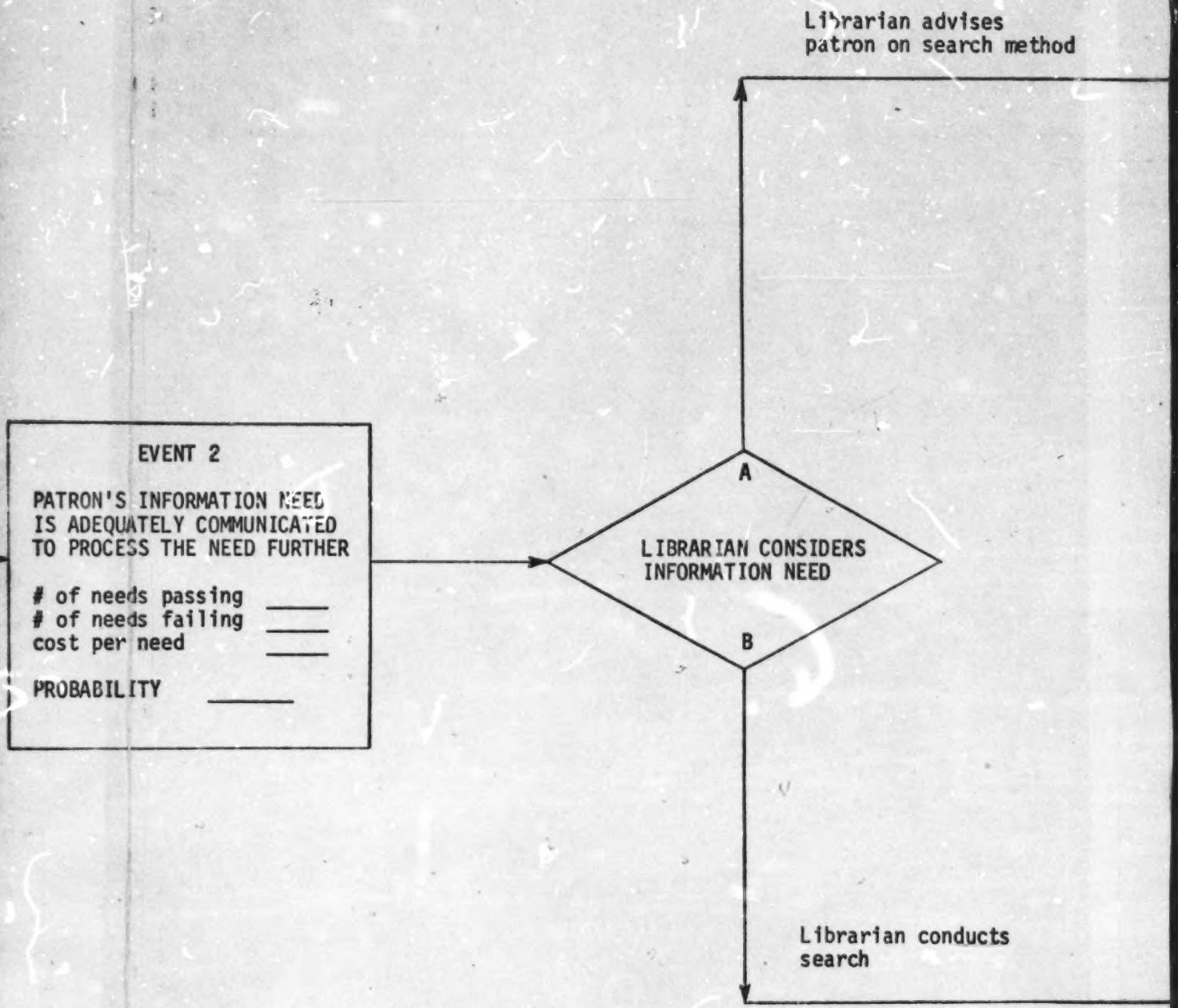

EVENT 1
PATRON CONTACTS LIBRARIAN
TO SATISFY NEED FOR INFORMATION
OR INSTRUCTION
# of information needs ____
Enter
Patron communicates
need for reference service

Figure 1


Librarian advises
patron on search method
EVENT 2
PATRON'S INFORMATION NEED
IS ADEQUATELY COMMUNICATED
TO PROCESS THE NEED FURTHER
# of needs passing
# of needs failing
cost per need
PROBABILITY
A
LIBRARIAN CONSIDERS
INFORMATION NEED
B
Librarian conducts
search

EVENT 3

PATRON IS DIRECTED TO APPROPRIATE REFERENCE MATERIALS BY LIBRARIAN

# of needs passing _____
# of needs failing _____
cost per need _____

PROBABILITY _____

| TYPE | SUB-PROBABILITY |
|---|---|
| a. card catalog | |
| b. indexes/abstracts | |
| c. subject bibliog. | |
| d. desk collection | |
| e. other | |

Librarian instructs patron on use of reference material

EVENT 5

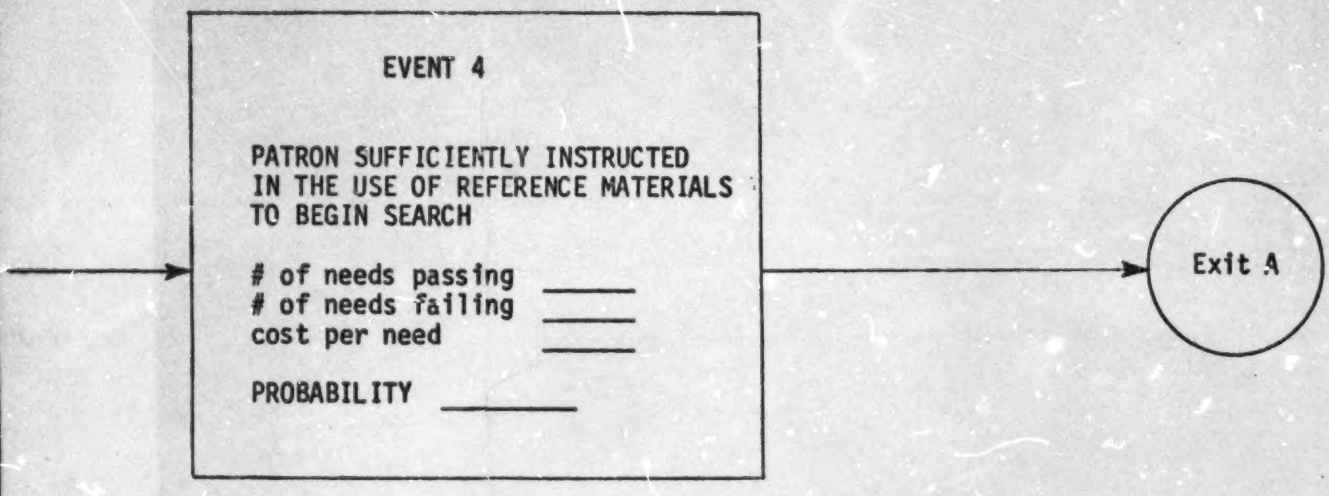
SOURCE DOCUMENTS IDENTIFIED BY LIBRARIAN

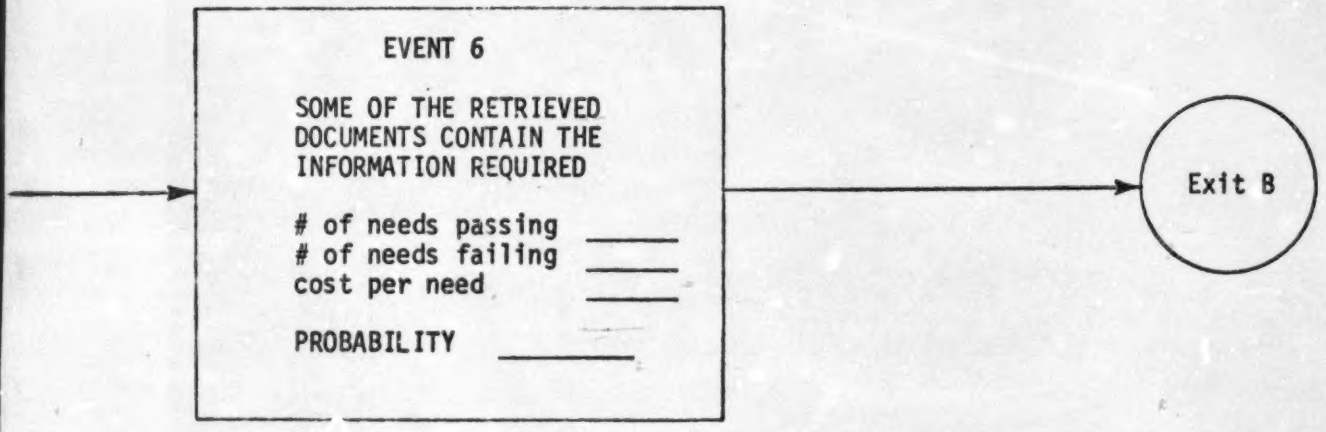
# of needs passing _____
# of needs failing _____
cost per need _____

PROBABILITY _____

| LOCATED IN | SUB-PROBABILITY |
|---|---|
| a. desk collection | |
| b. ref. stacks | |
| c. index area | |
| d. card catalog | |
| e. other | |

Librarian retrieves source documents


EVENT 4
PATRON SUFFICIENTLY INSTRUCTED IN THE USE OF REFERENCE MATERIALS TO BEGIN SEARCH
# of needs passing
# of needs failing
cost per need
PROBABILITY
Exit A


EVENT 6
SOME OF THE RETRIEVED DOCUMENTS CONTAIN THE INFORMATION REQUIRED
# of needs passing
# of needs failing
cost per need
PROBABILITY
Exit B

SCORE Analysis Data Sheet

Question received
742 in person
214 via telephone

I. Did the patron communicate his need for assistance well enough to begin working on the question?

yes 956 no 3

(Time spent 43.1 sec)

II. Did the librarian suggest a search methodology?

yes 416 no 4

(Time spent 81.7 sec)

IIa. Patron directed to:

| | | |
|---|---|---|
| (1) | card catalog | 163 |
| (2) | indexes/abstracts | 241 |
| (3) | subject bibliog. | 43 |
| (4) | desk collection | 51 |
| (5) | other (specify) | 56 |

III. Was instruction in the use of the above materials provided?

yes 272 no 144

(Time spent 139.4 sec)

IV. If the librarian conducted a search, were appropriate source documents identified?

yes 532 no 4

(Time spent 64.8 sec)

IVa. Documents in:

| | | |
|---|---|---|
| (1) | desk collection | 196 |
| (2) | ref. stax | 191 |
| (3) | index area | 86 |
| (4) | card catalog | 163 |
| (5) | other (specify) | 23 |

V. Did these sources contain the information required?

yes 456 no 76

(Time spent 118.2 sec)

Figure 2

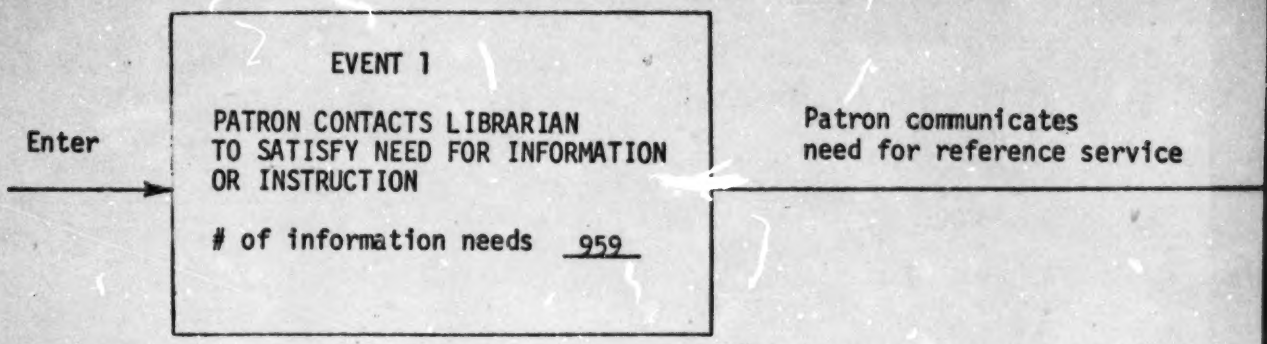
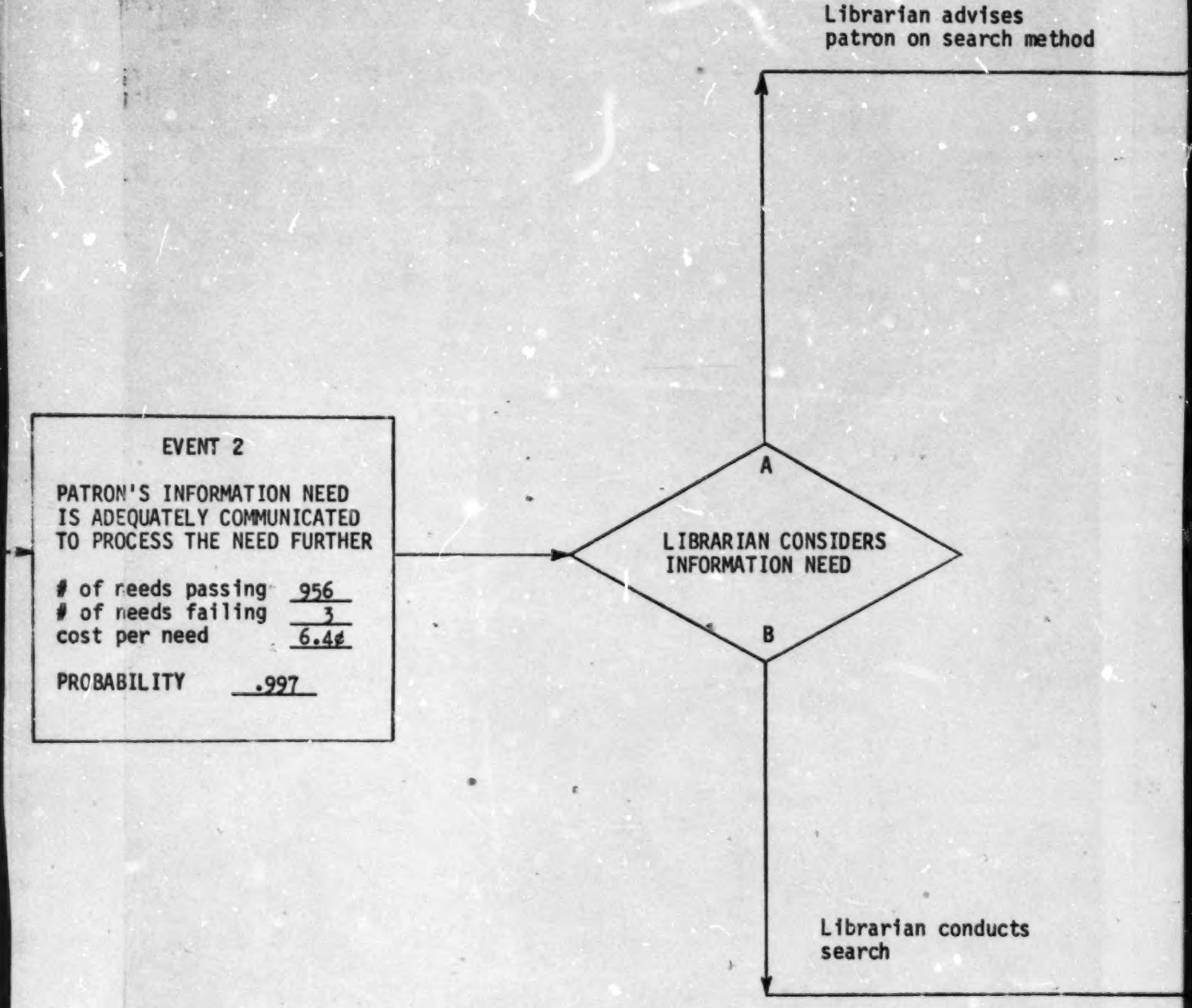

EVENT 1
PATRON CONTACTS LIBRARIAN TO SATISFY NEED FOR INFORMATION OR INSTRUCTION
# of information needs 959
Enter
Patron communicates need for reference service

Figure 3


Librarian advises patron on search method
EVENT 2
PATRON'S INFORMATION NEED IS ADEQUATELY COMMUNICATED TO PROCESS THE NEED FURTHER
# of needs passing 956
# of needs failing 3
cost per need 6.4¢
PROBABILITY .997
A
LIBRARIAN CONSIDERS INFORMATION NEED
B
Librarian conducts search

EVENT 3

PATRON IS DIRECTED TO APPROPRIATE REFERENCE MATERIALS BY LIBRARIAN

# of needs passing 416
# of needs failing 4
cost per need 14.9¢

PROBABILITY .990

| TYPE | SUB-PROBABILITY |
|---|---|
| a. card catalog | .393 |
| b. indexes/abstracts | .581 |
| c. subject bibliog. | .104 |
| d. desk collection | .123 |
| e. other | .135 |

Librarian instructs patron on use of reference material

EVENT 5

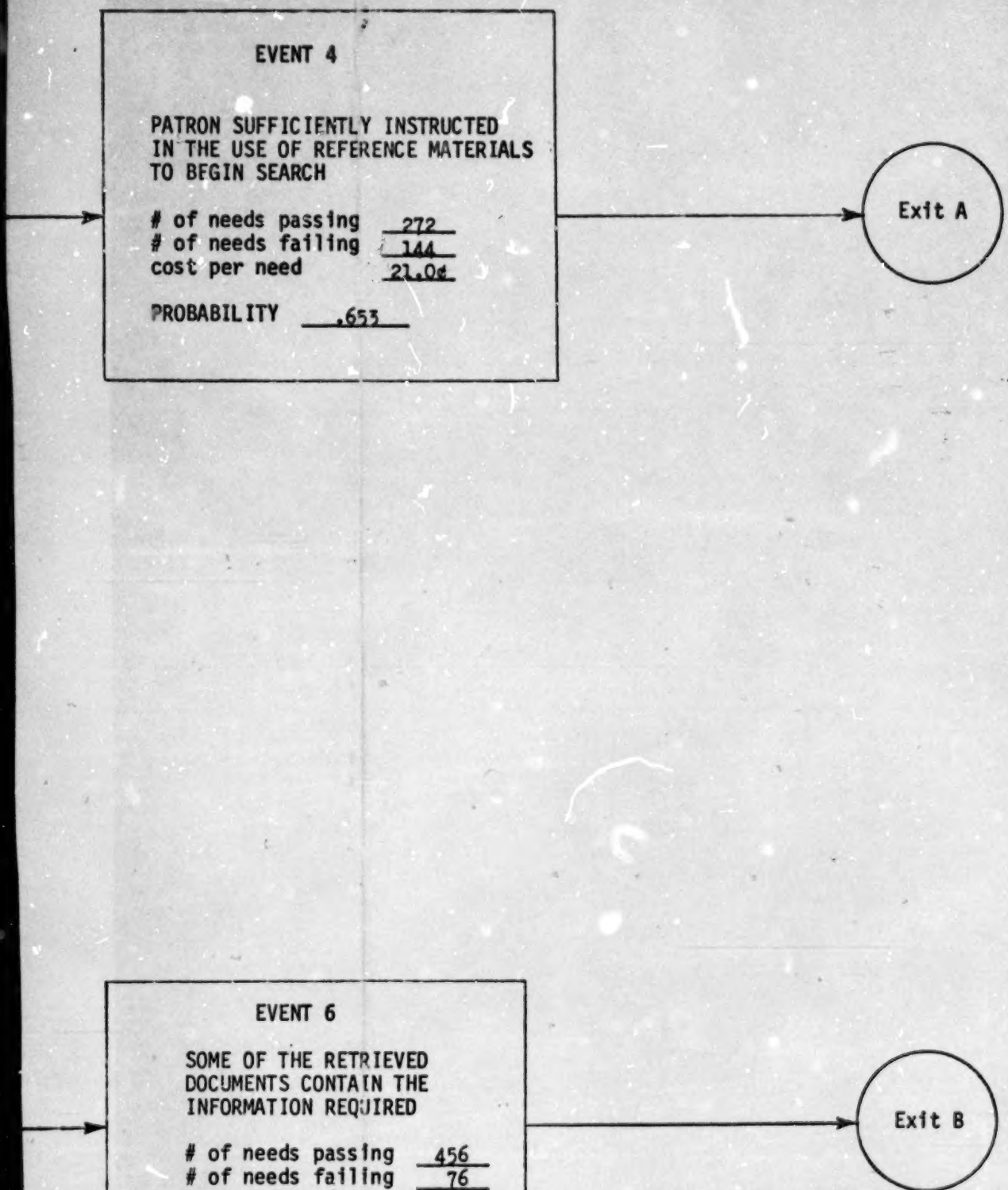
SOURCE DOCUMENTS IDENTIFIED BY LIBRARIAN

# of needs passing 532
# of needs failing 4
cost per need 9.9¢

PROBABILITY .991

| LOCATED IN | SUB-PROBABILITY |
|---|---|
| a. desk collection | .368 |
| b. ref. stacks | .359 |
| c. index area | .162 |
| d. card catalog | .306 |
| e. other | .043 |

Librarian retrieves source documents


EVENT 4
PATRON SUFFICIENTLY INSTRUCTED IN THE USE OF REFERENCE MATERIALS TO BEGIN SEARCH
# of needs passing 272
# of needs failing 144
cost per need 21.0¢
PROBABILITY .653
Exit A
EVENT 6
SOME OF THE RETRIEVED DOCUMENTS CONTAIN THE INFORMATION REQUIRED
# of needs passing 456
# of needs failing 76
cost per need 18.8¢
PROBABILITY .857
Exit B

SCORE Analysis Data Sheet

Question received
623 in person
192 via telephone

I. Did the patron communicate his need for assistance well enough to begin working on the question?

yes 815 no 0

(Time spent 46.0 sec )

II. Did the librarian suggest a search methodology?

yes 350 no 2

(Time spent 83.6 sec )

IIa. Patron directed to:

| | |
|---|---|
| (1) card catalog | 139 |
| (2) indexes/abstracts | 204 |
| (3) subject bibliog. | 39 |
| (4) desk collection | 42 |
| (5) other (specify) | 45 |

III. Was instruction in the use of the above materials provided?

yes 244 no 106

(Time spent 136.8 sec)

IV. If the librarian conducted a search, were appropriate source documents identified?

yes 459 no 4

(Time spent 68.8 sec )

IVa. Documents in:

| | |
|---|---|
| (1) desk collection | 116 |
| (2) ref. stax | 163 |
| (3) index area | 72 |
| (4) card catalog | 142 |
| (5) other (specify) | 21 |

V. Did these sources contain the information required?

yes 398 no 61

(Time spent 116.4 sec)

Figure 4

SCORE Analysis Data Sheet

Question received
122 in person
22 via telephone

I. Did the patron communicate his need for assistance well enough to begin working on the question?

yes 141 no 3

(Time spent 22.0 sec )

II. Did the librarian suggest a search methodology?

yes 66 no 2

(Time spent 67.6 sec )

IIa. Patron directed to:

| | |
|---|---|
| (1) card catalog | 24 |
| (2) indexes/abstracts | 36 |
| (3) subject bibliog. | 4 |
| (4) desk collection | 9 |
| (5) other (specify) | 11 |

III. Was instruction in the use of the above materials provided?

yes 28 no 38

(Time spent 138.9 sec )

IV. If the librarian conducted a search, were appropriate source documents identified?

yes 73 no 0

(Time spent 37.5 sec )

IVa. Documents in:

| | |
|---|---|
| (1) desk collection | 29 |
| (2) ref. stax | 26 |
| (3) index area | 12 |
| (4) card catalog | 19 |
| (5) other (specify) | 5 |

V. Did these sources contain the information required?

yes 58 no 15

(Time spent 181.5 sec )

Figure 5